FIFTH ANNUAL REPORT

OF THE

South Carolina Experiment Station

(CLEMSON AGRICULTURAL COLLEGE)

FOR THE

Year ending Dec. 31st, 1892.

CHARLESTON, S. C.
WALKER, EVANS & COGSWELL CO., PRINTERS,
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H. A. STRODE, President and Director.
J. S. NEWMAN, Vice Director, Agriculturist, Horticulturist and Head of Farm.
J. F. C. DuPRE, Asst. Horticulturist.
M. B. HARDIN, Chief Chemist.
R. N. BRACKETT, PH. D., Asst. Chemist.
C. W. SIMS, A. B., Asst. Chemist.
F. S. SHIVER, PH. G., Asst. Chemist.

Post Office is Fort Hill, Pickens Co., S. C.
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TABLE OF CONTENTS.

FORT HILL, S. C., JAN. 1st, 1893.

To his Excellency, B. R. TILLMAN, *Governor of South Carolina:*

I have the honor to submit, in accordance with the third section of the Act of Congress, known as the Hatch Act, the following Annual Report of the South Carolina Experiment Station, located at the Clemson Agricultural College.

Very respectfully,

H. A. STRODE,

Director.

REPORT OF DIRECTOR.

Col. J. S. Newman, who was mentioned in the last report as having been elected Agriculturist, Horticulturist, and Vice-Director of the Station, entered upon his duties on the 26th of January, 1892. His report and that of his assistant, Mr. J. F. C. PuPré, will show fully the work that has been done in agriculture and horticulture. The report of Col. M. B. Hardin, Chief Chemist, covers very fully the work done in his department. The failure to open the College February 1st, 1892, on account of the disappointment in regard to an appropriation from the Legislature, will explain why the Experiment Station could not have its staff increased, and work in other departments carried on. The year has been spent mainly in work on the farm and experiment grounds, as will be seen from the reports mentioned. Four bulletins for the year have been issued, in addition to the usual annual reports; and all have been distributed in the manner prescribed in the Hatch Act. Four or five thousand copies of each bulletin were sent out. Bulletin No. 5, the first one of this year, described the results of various methods of keeping sweet potatoes.

Bulletin No. 6 contains the analyses of commercial fertilizers.

Bulletin No. 7 gave an account of experiment with oats and wheat.

Bulletin No. 8 gave an exhaustive and scientific treatment of the analysis of cotton seed meal, particularly with reference to the available Phosphoric Acid.

The results of experiments made this year will be published in future bulletins.

The reports from co-operative soil-tests made by ten selected assistants among the practical farmers of the State, will constitute interesting material for a bulletin, as soon as they can be examined and placed in proper form.

H. A. STRODE,

Director.

S. C. EXPERIMENT STATION,
FORT HILL, S. C., October 31st, 1892.

Prof. H. A. Strode, Director S. C. Experiment Station :

DEAR SIR : I have the honor to report the following work done on the farm and experiment grounds of the Clemson Agricultural College between the 26th of January last, when I took charge, and the present date. I have endeavored, as far as the facilities at my command would permit, to carry out the plan of work adopted by the Board of Trustees at their meeting in Pendleton, January 19th, 1892.

For the farm and horticultural grounds 165 acres of new ground were prepared for cultivation.

In the river bottom 2 44 miles of under-drains were laid with brick, one-fourth mile of ditch straightened and half mile of open creek cleaned out.

Five and ninety-five hundredths (5.95) miles of new driveways have been opened, and much work in repairing old roads, changing old fences and building new ones.

The following areas were planted in the crops named :

130 acres of new ground in corn.
52 acres of bottom land in corn.
10 acres of sorghum.
25 acres in German millet.
6 acres of corn, sorghum and other forage plants for experiments.
3.6 acres of tobacco.
7 acres of sweet potatoes.
50 acres of peas after small grain.
45 acres of peas broadcasted for hay and soil improvement.
52 acres of peas broadcasted in corn on the bottoms.
130 acres of peas drilled in new ground corn.
8 acres in cotton.
18 acres of grasses and clovers.
5 acres of peas for green soiling.
5 acres of rye and wheat for green soiling
18 acres prepared for wheat to be sown this week.

The following areas, planted in small grain in 1891, were harvested and yielded as stated below :

80 acres planted, yielded of :
Oats, 878 bushels.
Rye, 9½ bushels.
Wheat, 6 bushels.

The following crops have been harvested to date, viz. :

Hay—Bermuda and other grass	30.93	tons.
Corn fodder	32.04	"
Pea vines	35.64	"
Sorghum fodder	1.87	"
Total	100.48	"

(A silo full of silage put up in 1891 being on hand, none was stored this year.)

Sorghum syrup . . 1,052 gallons, gross, mill measure.
Corn gathered . . . . 2,800 bushels.
Peas gathered . . . . 417¾ bushels.
Cotton gathered . . . 5,000 lbs. in the seed.
Cotton to be gathered .1,500 " " "
Sweet potatoes . . . 222½ bushels.

FIELD EXPERIMENTS.

With Corn—Soil tests of fertilizers.
Comparison of varieties.
Effects of detasseling.
Effects of pulling fodder.
Comparison of prepotency of male and female organs.
Comparison of method of preparing new ground.

With Cotton—Soil tests of fertilizers, embracing—
(*a*) On sandy new ground.
(*b*) On old red loam.
(*c*) Special nitrogen tests on old red soil.
Cross-bud varieties, 70 in number.
Comparison of varieties, 21 in number.

Forage Plants—Comparison of species and varieties for green soiling as to yield and nutritive value, 18 varieties.
Comparison for silage, 4 varieties.

Sorghum—Comparison of yield of eleven varieties in syrup per acre and per 1,000 lbs. of cane.
Tested also for sugar in the chemical laboratory.

Tobacco—Soil test of fertilizers.
Comparison of 40 varieties.
Comparison of methods of curing.
Grass—Comparison of methods of preparing for.

NEEDS OF FARM AND STATION.

The most pressing present need is a fertilizer house, to be used for storing fertilizing material, manipuluting composts and mixing chemicals for experiment purposes.

As early as practicable pasturage for swine should be fenced in and stock hogs of four breeds, in trios, provided. In addition to these there should be eight low grade sows, to be bred in pairs to the thoroughbred males, for the purpose of comparing the half-breeds as pork producers.

As rapidly as the means at command will allow compact bodies of land, not interrupted by drives, should be fenced with two wires, in order that cattle may glean the fields.

Two more breeds of cattle should be provided in trios in order that the profits of these thoroughbreds may be compared; but of greater importance as a matter of public interest is the comparison of the grades bred from these thoroughbred sires. A dairy of sufficient capacity to handle the milk of fifty cows should be provided as early as practicable and thoroughly equipped with the most approved appliances of both dairies and creameries; and to this should be attached a room for manufacturing cheese and one for curing the same. Connected with the dairy should be a class-room for special instruction in that department, but this is more elaborately discussed under the head of Suggestions as to Necessary Preparations for Opening the College (in another report).

I suggest that the mules on the farm be gradually disposed of as they can be sold to advantage, and their places supplied by mares.

The number of mares should be twice that actually required to perform the labor of the Farm and Horticultural Department. Half of the mares should be bred in March and April and half in August and September, in order that at least half shall be in condition for work at all times. Two stallions should be kept—one thoroughbred for saddle and and light draft, and one for heavier draft and trotting.

One jack should also be kept, and all these offered to the public at reasonable rates, to encourage improvement in the stock of the surrounding country.

Enough convict labor should be supplied to cultivate those parts of the farm too remote from the College to be cultivated by students, to complete during the approaching Winter the system of driveways, to continue the improvements of the creek and river bottoms, and to prepare lands too steep for cultivation for use as pastures.

I desire to express my appreciation of the interest you have ever manifested in the success of my work and your willingness to contribute as far as in your power to its success.

I am under obligations also to the President of the Board of Trustees and the Secretary of the Board for courtesies and support in the arduous labor of the year.

While all of those assigned to assist me have faithfully discharged their duty, I wish especially to express my recognition of the invaluable services rendered by Mr. J. F. C. DuPre, whose report of work done in horticulture accompanies this. He has applied himself with untiring energy and fidelity, and has conquered a magnificent success under most trying circumstances. I desire also to express my high appreciation of the services, sound judgment and sterling integrity of Mr. J. S. Pickett, foreman of the farm.

Respectfully submitted,

J. S. NEWMAN,
Vice-Director.

REPORT OF THE HORTICULTURIST.

SOUTH CAROLINA EXPERIMENT STATION,
FORT HILL, S. C., October 31st, 1892.

To Prof. J. S. Newman, Vice-Director.

DEAR SIR:—The following report is respectfully submitted after a few hours' notice, and is of necessity both crude and incomplete.

Work in the Horticultural department was begun on 28th January, 1892, under your general and personal supervision.

Most of the lands allotted to us were in original forest, the remainder was in old fields ornamented with gullies, galled clay spots, Bermuda grass and quartz rock. All of it was poor hillside and ridge land. The gullies were the outcome of so-called hillside ditches.

All these lands have been properly terraced, thoroughly

cultivated and are now in much better condition, mechanically and otherwise, than when taken in hand. They have been planted in fruit and nut-bearing trees, grape vines, berry plants and vegetables. The trees and grape vines have been planted upon the terraces, alternating each other, except in the case of Delaware and Scuppernong grapes, which are planted in plats to themselves.

The aggregate fruit and nut-bearing trees planted is 1,442, as follows:—

265 apples, in variety.
241 pears, "
311 peaches, "
170 plums (100 Oriental and 70 Wild Goose.)
24 figs, in variety.
24 cherries, "
51 currants, "
31 gooseberries, "
12 quinces, "
100 pecans, "
20 walnuts, "
12 filberts, "
6 chestnuts.
50 miscellaneous, and
105 mulberries (the larger portion of which are planted in hog pasture.)

1,422

Of the above, only about half dozen fruit trees and about 20 pecans have died.

GRAPES.

1,085 grape vines and cuttings in many varieties were planted. With very few exceptions these all lived, and have put on a good growth. As in the case of the trees above mentioned, where there were six or more of one kind, they were divided and planted on different exposures. Both the trees and the vines have been trimmed and cultivated, and I am now making trellises for the grapes.

POTATOES.

On the 2d and 3d days of March we planted on the Pendleton road $\frac{96}{100}$ acres in Irish potatoes as a general crop. But included in this area were several experiments, to wit:

Planting *whole* potatoes, both by the hill and by the pound. Potatoes cut to one and two eyes, also stem end, bud end, middles, &c. Also experiments as to distances and modes of cultivation. Of these experiments the yield from the *bud* end of potatoes was largest (407 bushels per acre), and in distances those planted 36x20. The total yield of this plat was 296 bushels, equal to 308⅓ bushels per acre.

On the 2d and 3d of April we planted 165 hills each of 47 different varieties, 36x20, in same field as above. The average yield of this variety test was 210 bushels per acre, ranging from 94 the lowest, to 328, the highest. It is proper to state that the late planting and a short drouth just after the planting greatly reduced the yield. A full description as to growth, time of maturity, size, shape, number of eyes, keeping qualities, &c., has been made of each and every variety, together with yield per acre, and will appear in Bulletin at proper time.

SECOND CROP.

We were prevented from making second crop by lack of labor at proper time to prepare and plant. This, as a rule, has been my best crop, and the potatoes are better keepers and better seed.

STRAWBERRIES.

Seven thousand plants of ——— varieties were set out in March on old, poor and cloddy land, but the plants lived, grew well, and made quite a crop of very fine berries. I am now extending this plant by setting out the runners from the old vines, and when done will have fully one acre. Observations as to growth of plant, date of flowering, size, shape and flavor of berry have been made and properly noted down. With water supply a very fine late or second crop could have been made, which, if the school was open, would have been very desirable.

CANTALOUPES.

Forty-three varieties of cantaloupes were planted, aggregating 1,500 hills. The average yield was good, especially the earlier crop. The late fruit was mostly injured by worms, of which there was a full crop.

Observations as to 38 of these varieties were made, noting date of ripening, size, shape, color, thickness of rind, thickness of flesh, color and texture of flesh, netting, corrugation, quality, &c., all of which is recorded for future reference.

BEETS.

Of the fifteen varieties planted all did well, and proper note made of merits and demerits.

WATERMELONS.

Thirty-four varieties planted, all upon high ridge new ground. Some varieties in duplicate to test seed grown North and South and seed from different seedsmen, Duplicates were also found under *different names*, &c. Aggregate number of hills, 1,265.

Tests and observations of varieties as to date of ripening, size, shape color of rind, color of flesh and seed, thickness of rind, texture, flavor, &c., were made and notes recorded.

The yield was entirely satisfactory, and surplus found ready sale.

CUCUMBERS.

Thirteen varieties. Usual notes as to size, shape, &c. Fed to convicts, hogs, &c., and several barrels packed in salt and brine for winter use.

TOMATOES.

Thirty-three varieties transplanted. Several others, seed did not germinate. Tested plants on both old and new ground. Result in favor of old land.

Observations as to growth of plant, disease, maturity of fruit, yield, color, shape, weight, both gross and net, size of core and of cavity near seed, flavor, &c., carefully made and noted.

Earliest crop destroyed by worms; succeeding good. Fully half or more decayed before canning house was completed. Put up 850 three-pound cans. If plant had been ready, could have canned 2,500 at very small expense. In July and early in August planted second crop from limbs or cuttings taken from old plants. An almost continuous drouth from the

time of planting delayed the growth and the ripening, but they made a fine crop of choice fruit. The vines have been taken up and placed in basement of chapel, where a large portion of the fruit will ripen. As in the case of other vegetables, a supply of water for irrigation would have secured a paying crop.

CABBAGE.

Thirteen thousand nine hundred and forty-one plants of thirty-seven varieties were transplanted, and all did well except about 4,000 set out in the river bottom, which were killed by the overflow. These were fed to the convicts, cattle, hogs, etc., and several barrels put away in salt and brine for winter use, and which are keeping well. The usual memoranda as to date of heading, size, shape, etc., keeping qualities, number of heads per 100 plants, etc., was made and is on record. By a series of accidents and other circumstances that we could not control, the entire lot of plants intended for a fall and winter crop were destroyed.

About 1,000 plants of a still later planting were set out, but too late to expect a good crop.

Parsnips,	2 varieties.
Carrots,	5 varieties.
Okra,	2 varieties.
Pepper,	2 varieties.
Squashes,	2 varieties.

ONIONS.

About $\frac{1}{3}$ acre of Silver Skin, from *sets*, were planted as general crop. Yield 44 bushels, and entirely satisfactory. Onions rotted badly. One-sixth acre, planted in Yellow Danvers Globe from *seed*, produced $25\frac{2}{5}$ bushels large smooth onions, which are still firm and sound. Yield equal to 157 bushels per acre. Ten and a half bushels from seed on another plat.

Twenty-three varieties in small plats, from seed, produced sets, which sets are now growing side by side as a continued test.

BEANS.

Thirty-four varieties of Bunch or Dwarf Beans and eight varieties of Lima and other Pole Beans. Yield of Lima and Pole Beans satisfactory. Three crops of Bunch Beans were made, the frost catching a portion of the latest crop.

Observations as to growth of plant, time of fruiting, diseases, color, shape, size, tenderness, strings, etc., of pods, were made and noted down. Product fed to convicts, and seven barrels packed down in salt.

One thousand asparagus roots.

TURNIPS.

Planted four varieties in March. Two of these, the Red Top Munich and White Norfolk Globe, got up to a stand. Both did exceedingly well, the Norfolk Globe succeeding the Munich, and lasting until other vegetables came in.

Something over one-half acre in Ruta Bagas, planted in July, and two or three acres in improved Seven Top at intervals in August and September, are doing as well or better than we expected, considering the almost continuous drouth since planting.

Other vegetables have been planted and other experiments made, but time will not permit mention of them now. Taking all the conditions and circumstances into consideration—the quality and condition of the land, the late date at which work began, the lack of labor and of implements, and other needed facilities—the result has been gratifying to me, and I hope satisfactory to you and to the Board of Control.

From the date when the turnips came in the Spring until this writing, the convicts have had a continuous ample supply of all the vegetables that they needed, and the surplus sold, packed away or fed to the stock.

Our needs in this department are now a more comfortable house for office and experimental purposes; second, improved tools for cultivation, implements and articles for destroying insects, gathering fruits, etc.; third, facilities for raising and propagating plants for future use—that is to say, a series of hot-beds, cold-frames, etc., or, what would be better, and perhaps not more expensive, a propagating house, say 18x75 feet, properly heated, etc.; and lastly, but by no means the least, a system of water works that will enable us to supply any deficiency from rain and to grow crops that need irrigation.

With sincere thanks for much needed assistance and advice freely rendered by you, I have the honor to be,

Yours very truly,

J. F. C. DuPRÉ,
Assistant in Horticulture.

REPORT OF THE CHEMIST.

FORT HILL, S. C., Nov. 1st, 1892.

PRESIDENT H. A. STRODE, Director.

I herewith respectfully submit my annual report, which in accordance with instructions is made to cover the period extending from November 1st, 1891, to November 1st, 1892.

The contents are, in outline, as follows:

I. Arrangement of the work.
II. Summary of the work.
III. Analyses of cattle-foods.
IV. Analyses of sugar producing plants and juices.
V. Analyses of fertilizers used at the station.
VI. State analysis.
  (1) Official samples of commercial fertiliaers.
  (2) Farmers' samples of commercial fertilizers.
  (3) Mineral and potable waters.
  (4) Ores and minerals.
  (5) Clays.
  (6) Marls.
  (7) Miscellaneous articles.

I. Arrangement of work.

The chemist has had the general direction and supervision of all the different lines of work, giving special attention wherever it was most important and engaging in the analytical work whenever it was necessary. He has attended personally to all the correspondence and to the records of the department, and has made a full report of the State analysis to the Board of Fertilizer Control. A considerable portion of the year has been devoted to the study of some points in the composition of cotton seed meal and a bulletin has been prepared and presented, which gives the result of this investigation.

The distribution of work among the assistants has been as follows:

Analysis of cattle foods and other vegetable products; Mr. F. S. Shiver.

Analysis of commercial fertilizers, Messrs C. W. Sims and F. S. Shiver, Dr. R. N. Brackett taking Mr. Shiver's place when the latter was engaged in the examination of feeding stuffs, &c.

Analysis of waters, ores, clays, &c; Dr. Brackett and Mr. Sims, Mr. Shiver assisting when not otherwise employed.

Assay of gold ores and miscellaneous work; Dr. Brackett.

II. Summary of the work.

The equipment of the rooms in the laboratory used for experiment station work has been nearly completed, the apparatus arranged as well as possible under the circumstances and the instruments imported from Europe have been tested. The chemical work accomplished may be briefly stated as follows.

A series of experiments has been made with the view of determining the average amounts of available phosphoric acid and water-soluble potash in cotton seed meal, the analysis of eleven samples giving an average result of 2.48 per cent. of available phosphoric acid and of 1.57 per cent. of potash soluble in water, the analysis showing also that over $\frac{9}{10}$ of the total phosphoric acid in the meal is available and that over $\frac{8}{10}$ of the total potash is soluble in water. Certain observations made during the course of these experiments led to an investigation which showed that not only ordinary phosphoric acid but also meta—and pyro—phosphoric acid occurred in all of the samples of meal examined. The salts of the last two acids are said to be more or less poisonous, and though their precise physiological action, has not, I believe, been determined, it is quite possible that some of the peculiar, and in certain cases injurious and even fatal effects produced by the use of cotton seed and cotton seed meal as feeding stuffs may be due, in a measure at least to the presence of these meta–and pyro-compounds. The following articles have been analyzed for the station; 6 samples of fertilizing materials; 3 samples of ensilage; 9 samples of forage plants and 11 samples of sorghum juice.

The following have been analyzed for the State; 213 official samples of fertilizers, 23 farmers samples of fertilizers, 26 mineral and potable waters, 11 ores and minerals, 7 clays, 3 marls and 15 miscellaneous articles including 3 samples from sugar beets sent on to the laboratory from Camden.

Leaving out all of the numerous duplicate analyses and such miscellaneous examinations as did not require quantitative determinations, there have been made 327 analyses during the year.

III. ANALYSES OF CATTLE FOODS.

	Station No.	Water	Dry Matter	One hundred parts of Dry Matter.				
				Protein*	Fat.	N. Free Extract	Fiber	Ash
Millo Maize Ensilage	502	74.67	25.33	8.80	2.68	50.21	31.11	7.20
Corn Ensilage	500	71.14	28.86	10.62	3.34	58.74	22.16	5.14
Sorghum Ensilage	501	72.19	27.81	8.15	3.97	58.58	23.89	5.41
Orange Sorghum	644	76.27	23.73	4.21	1.75	65.84	25.63	2.57
Orange Sorghum. *not fertilized.*	645	78.68	21.32	9.68	2.54	53.77	26.75	7.26
Rural Branching Sorghum	646	69.74	30. 26	4.57	1.40	61.29	29.81	2.93
Millo Maize	647	69.61	30.39	4.41	1.52	64.69	26.37	3.01
Kaffir Corn	648	65.82	34.18	5.60	2.69	57.19	31.32	3.20
Jerusalem Corn	649	60.24	39.76	5.29	1.86	58.92	30.34	3.59
Common Corn	650	70.04	29.96	3.58	1.21	66.22	26.42	2.57
Pearl Millet	651	68.62	31.38	5.69	1.24	52.86	6.54	3.67
Teosinte	652	81.17	18.83	9.71	1 34	60.04	24.52	4.39

*Protein=Total Nitrogen x 6.25.

IV. ANALYSES OF SUGAR PRODUCING PLANTS AND JUICES.

SUGAR BEETS.

SENT ON FROM CAMDEN, S. C.

Station No.	Average Weight in Pounds.		Per Cent. Cane Sugar in Beet	Per Cent. of Juice	Sp. Gr. of Juice	Total Solids in Juice	Cane Sugar in Juice	Purity	Number of Beets in Sample
	Before Dressing	After Dressing							
610	.80	.65	6.50	96.79	1.04720	11.70	6.71	57	3
610	1.12	.96	8.10	96.10	1.05149	12.72	8.43	66	2
610	2.06	1.86	3.70	97.06	1.03765	9.39	3.81	41	1

SORGHUM JUICES.

Station No.	MARKS.	Total Solids (Brix)	Sp. Gravity (17½ c.)	Solids not Sugar	Cane Sugar	Reducing Sugars (Glucose)
656	Black African	16.07	1.0660	3.90	8.00	4.17
657	McLeans	16.59	1.0682	7.09	4.40	5.10
658	Planter's Favorite	17.07	1.0704	7.07	2.81	7.19
659	Coleman's Cane	15.97	1.0656	4.64	5.63	5.70
660	Folger's Early	17.43	1.0717	3.26	6.62	7.55
661	Variety "91"	17.59	1.0726	4.04	9.30	4.25
662	Gray Eagle	16.39	1.0674	4.91	6.18	5.30
663	Orange	16.39	1.0674	3.71	5.92	6.76
664	Coleman's Red	17.87	1.0739	5.38	8.01	4.48
665	Link's Hybrid	16.24	1.0665	5.02	6.90	4.32
666	Collier's	18.71	1.0775	10.63	4.21	3.87

V. FERTILILIZING MATERIALS.

Station Numbers	436	437	438	439	440	441
	Sodium Nitrate.	Ammonium Sulphate.	Cotton-Seed Meal.	Acid Phosphate.	Floats.	Kainit.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Soluble Phosphoric Acid	.....	.....	.....	12.82	.....	.....
Reverted Phosphoric Acid	.....	.....	.....	2.44	.....	.....
Available Phosphoric Acid	.....	.....	.....	15.26	.....	.....
Insoluble Phosphoric Acid	.....	.....	.....	1.13	.....	.....
Total Phosphoric Acid	.....	.....	.....	16.39	[1]26.47	.....
Nitrogen	15.51	20 44	6.97	.....	.....	.....
Equivalent to Ammonia	18.83	24.81	8.46	.....	.....	.....
Potash	.....	.....	.....	.....	.....	[2]12.35
Relative Commercial value	$48.93([3]	$64.51([3]	$22.00([3]	$15.26	.....	$12.35

(1.) 26.47 per cent. total phosphoric acid=57.81 per cent. bone-phosphate of lime. No trade value is assigned to insoluble phosphoric acid.

(2.) 12.35 per cent. potash; 22.84 per cent. sulphate of potash.

(3.) Based upon average value of ammonia for the season of 1891-92.

VI. STATE ANALYSIS.

(1.) *Official Samples of Commercial Fertilizers, as reported in Bulletin No. 6 of this Experiment Station.*

(2.)—FARMERS' SAMPLES OF COMMERCIAL FERTILIZERS.

	Station No.	Moisture	PHOSPHORIC ACID					Nitrogen	Equivalent to Ammonia	Potash, Soluble in Water	Relative Commercial Value	SENT ON FROM
			Total	Insoluble	Soluble	Reduced or Reverted	Available					
		p. c.	p. c.	p. c.	p. c.	p. c.	p. c.	p. c	p. c	p. c.	$ cts	
Ammoniated.	349	12.20	6.66	0.59	5.15	0.92	6.07	3.97	4.82	10.39	27.95	Annandale
"	357	7.76	11.45	0.98	7.39	3.08	10.47	2.68	3.25	0.96	19.88	Twiggs
"	475	10.18	12.38	3.08	5.82	3.48	9 30	1.65	2.00	1.07	15.57	Kinard's
"	476	11.35	12.01	2.76	5.81	3.44	9.25	1.70	2.07	1.06	15.69	Kinard's
"	568	7.70	9.16	0.49	7.27	1.40	8.67	6.75	8.19	2.69	32.65	Young's Isl'd
"	585	2.32	5.04	1.64	0.51	2.89	3.40	0.55	0.67	0.09	5.23	Sumter
"	586	8.30	12.86	3.08	5.92	3.86	9.78	1.07	1.30	1.07	14.23	Eulala
"	602	10.59	14.47	2.44	8.60	3.43	12.03	2.26	2.74	2.50	21.65	Goldville
"	603	8.40	17.95	2.46	10.31	5.18	15.49	1.62	1.97	2.33	22.94	Goldville
"	604	10.61	12.35	3.30	5.83	3.22	9.05	2.40	2.92	0.99	17.63	Goldville
"	616	2.19	4.23	1.16	0.14	2.93	3.07	0.42	0.51	0.02	4.42	Cartersville
"	617	5.14	5.42	0.9.	1.27	3.16	4.43	0.74	0.90	0.15	6.92	Lamar
"	619	2.96	3.42	2.56	0.08	0.78	0.86	1.96	2.38	0.04	7.09	Cypress
"	620	1.66	0.93	0.59	0.03	0.31	0.34	0.62	0.75	0.04	2.33	Columbia
"	623	15.27	9 12	2.78	4.89	1.45	6.34	2.92	3.55	2.32	17.89	Spartanburg
"	624	3.70	1.39	1.22	0.08	0.09	0.17	0.63	0.77	0.03	2.20	Sumter
"	625	16.52	11.62	1.87	7.77	1.98	9.75	1 70	2.06	1.82	16.93	Summerton
"	626	18.40	9.45	1 14	6.97	1.34	8.31	2.11	2.56	2.27	17.24	Summerton
"	635	16.85	11.13	3.28	5.85	2.00	7.85	2.09	2.54	1.10	15.55	Mars Bluff
"	636	15.07	11.23	2.01	6.40	2.82	9.22	2.21	2.68	2.03	18.22	Elliott
"	637	16.23	8.38	1.19	4 94	2.25	7.19	2.65	3.22	2.01	17.57	Lamar
Bone Meal.	569	5.10	22.45	12 34	0.21	9.90	10.11	3.26	3.96	.....	20.41	Bennettsville
Kainit.....	514	.....	.....	.....	.....	.....	.....	.....	.....	12.93	12.93	Clio

Attention is directed to the low grade of Nos. 585, 616, 617, 619, 620 and 624.

(3.)—WATERS.

Grains per U. S. Gallon of 231 cubic inches.

Station Number	350	444	445	611	612	621	352	348
Sodium Carbonate	1.737	11.411	12.012	0.511	0.288	1.550	0.010	0.873
Potassium "	.....	0 218	0.276	.....	.....	.....	.....	0.259
Lithium "	Trace	.....	.....	.....	.....	.....	.....	Faint Trace
Calcium "	3.196	0.448	0.495	0.228	1,532	6.956	6.144	0.864
Strontium "	.....	.....	.....	.....	.....	Trace	.....	.....
Magnesium "	2.033	0.319	0.342	0.026	0.141	8.332	1.212	0.601
Sodium Sulphate ..	0.358	.....	.....	.....	0.128	.....	0.034	.....
Potassium "	0.320	1.016	0.946	0.070	0 128	0.977	0.085	0.139
Sodium Chloride...	0.624	0 509	0.603	0.090	0.122	3.306	0.404	0.298
Potasium "	.....	.....	.....	0.066	.. ..	0 312	.....	.....
Iron Sesquioxide & Alumina	0.069	0.041	0.052	0.011	0.055	0.181	0.117	0.239
Manganese Sesquioxide.....	.....	.....	.....	.....	.....	Trace	.....	Trace
Silica	2.682	1.605	1.714	0.822	0.749	2.776	1.009	0.665
Organic Matter	.....	.....	.....	Trace	Trace	Distinct	.....	.....
Total.....	11.019	15.567	16.440	1.824	3.143	24.390	9.015	3.938

Grains per U. S. Gallon of 231 cubic inches.

Station Number	631	654	627	615	629	630
Sodium Carbonate	0.490	0.185	.....	.....	0.199	.....
Potassium "	.....	0.048	.....	.....	.....	.....
Ammonium "	.....	0.008	.....	.....	0.002	.....
Calcium "	0.625	1.218	0.227	0.767	1.929	3.1137
Strontium "	.....	.. ..	Trace	.....	Trace	Trace
Magnesium "	0.317	0.061	0.083	.....	1.399	1.3400
Sodium Sulphate	.....	.....	.....	.....	0.011	.....
Potassium "	0.089	.....	0 064	.....	0.079	0.3045
Calcium "	.....	.....	.....	0.031	.....	.....
Sodium Chloride	0.207	0.452	0,385	2.373	0.141	11.0661
Potassium "	0.006	.....	0.099	0.145	.....	0.6024
Magnesium "	.....	.....	0.008	0.878	.....	.....
Ammonium "	.....	.....	.....	0.010	.....	.....
Sodium Nitrate.....	0.075	0.057	.....	.....	.....	5.5330
Calcium "	.....	.....	.....	1.488	.....	.....
Magnesium "	.....	.....	0.059	0.485	.....	2.2137
Ammonium "	0.005	.....	0.058	.....	0.005	0.0438
Magnesium Nitrite	.....	.....	.....	.....	.....	0.4214
Iron Sesquioxide and Alumina..	0.047	0.052	0,047	0.017	0.093	0.1457
Manganese Sesquioxide.....	Trace	.....	.....	.....	.....	.....
Silica.....	1 236	0.641	0.706	0.656	0.562	0.3324
Organic Matter.....	Tr ce	.....	Trace	Distinct	Trace	Large
Total.....	3.097	2.722	1.736	6.850	4.420	25.1167

Grains per U. S. Gallon of 231 cubic inches.

Station Number	338	339	618	622	639	643
Calcium Carbonate	2.851	4.789	3.700	1.934	5.308	4.338
Magnesium "	0.193	1.714	0.655	0.600	2.883	2.782
Lithium "	Traces	Distinct Traces	.....	.....	.....	.....
Calcium Sulphate	5.158	31.154	15.914	15.907	12.779	86.740
Strontium "	.....	.....	.....	Traces	.....	0.887
Potassium "	0.836	0.567	0.423	0.418	0.526	0.518
Sodium "	1.749	3.625	3.259	2.656	2.781	3.088
Lithium "	.....	.....	Traces	Traces	.....	.....
Sodium Chloride	0.259	0.649	0.222	0.612	0.961	0.490
Magnesium Nitrate	.....	.....	.....	.....	0.056	0.089
Ammonium "	.....	.....	.....	.....	0.004	0.005
Iron Sesquioxide & Alumina	Traces	.....	0.087	0 035	0.076	0.058
Silica	1.318	1.852	2.373	1.878	2.199	2.246
Organic Matter	.....	.....	Trace	.....	.....	Trace
Total	12 364	44.350	26 633	24.040	27.573	101.241

GRAINS PER U. S. GALLON OF 231 CUBIC INCHES.

Station Number.	353.	406.
Sodium carbonate	0 276	.....
Potassium carbonate	0.108	.....
Lithium carbonate	Trace.	.....
Calcium carbonate	0.467	0.098
Magnesium carbonate	0.191	0.244
Iron carbonate, (ferrous)	.....	1.298
Zinc carbonate	.....	0.274
Copper carbonate	.....	Trace.
Potassium sulphate	0.050	0.100
Calcium sulphate	.....	0.160
Sodium chloride	0.163	0.470
Potassium chloride	.....	0.086
Iron sesquioxide, (Fe_2O_3)	0.070	.....
Manganese sesquioxide, (Mn_2O_3)	0.093	.....
Cobalt oxide	Traces.	.....
Copper oxide	Distinct. Traces.	.....
Alumina	Trace.	Trace.
Calcium phosphate, [$Ca_3(PO_4)_2$]	Trace.	.....
Ammonium nitrate	Trace.	.....
Silica	1.050	0.304
Organic matter	Traces.	Traces.
Total	2.468	3.034

No. 350 was sent from Daufuski Island.
Nos. 444 and 445 were sent from Walterboro.
Nos. 611 and 612 were sent from Walhalla.
No. 621 was sent from Cross Hill.
No. 352 was sent from Orangeburg.
No. 348 was sent from Greenwood.
No. 631 was sent from near Laboratory, Fort Hill.
No. 654 was sent from Blacksburg.
No. 627 was sent from Anderson.
No. 615 was sent from Walhalla.
No. 629 was sent from Blacksburg.
No. 630 was sent from Columbia.
No. 338 was sent from Greenville.
No. 339 was sent from Laurens.
No. 618 was sent from Spartanburg.
No. 622 was sent from Greenville.
No. 639 was sent from Ninety-Six.
No. 643 was sent from Anderson.
No. 353 was sent from Donnaldsville.
No. 406 was sent from Gaddy.

Number 621 contained 0.136 cubic inches of sulphuretted of hydrogen per gallon; actual ammonia, 0.97 parts per million; albumenoid ammonia, 0.22 parts per million. Water unfit to drink.

Number 615 suspicious.

Number 630 contained parts per million; actual ammonia, 0.20; albumenoid ammonia, 0.18; nitric acid, (N_2 O_5) 87.90; nitrous acid, (N_2 O_3) 5.17; chlorine, 119.90. A highly contaminated and dangerous water. It should be stated, that after this analysis was completed information was received that common salt had been thrown into the well before the sample was collected.

Number 348 was turbid. There was a heavy ochreous deposit in the containing vessel, consisting mainly of oxide of iron, associated with small quantities of the oxides of manganese and cobalt. This is a chalybeate water, and an analysis of it at the spring would probably show a considerable quantity of iron carbonate in solution.

Number 353 is a chalybeate water. An examination at the spring would be necessary to determine the full amount of iron in solution.

Number 406 is also a chalybeate water. While some of the iron had apparently separated out from the sample sent, there still remained in solution about 1.3 grains of iron carbonate per gallon.

In addition to the foregoing, the following partial sanitary examinations were made:

Station Number.	356.	655.	640.	641.
Total solids; grains per U. S. gallon	20.207	19.653	3.615	3 942
Chlorine; grains per U. S. gallon	2.572	2.740	0.198	0.227
Actual ammonia; parts per million	0.08	0.132	0.02	0.03
Albumenoid ammonia; parts per million	0.04	0.062	0.03	0.06

Numbers 356 and 655 from same well in Pendleton—the first sample received February 5th, the second October 18th, 1892. Water suspicious.

Number 640, Fort Hill, "Lewis Creek." A good water.

Number 641, Fort Hill, "Spring Branch." A good water.

(4.) ORES AND MINERALS.

Station Number	Sent on from	
340	Anderson	Brown iron ore. Metallic iron—54.66 per cent.
343	Long Creek	Dolomite, magnesian limestone. Moisture at 100° ... 0.18 pr. c Calcium carbonate ... 48.48 " Magnesium carbonate ... 40.67 " Sesquioxide of iron & aluminum 1.47 " Silica and insoluble matter ... 9.56 " 100.36 " Talc. specimen composed of qnartz, feldspar and epidote; specimen composed of quartz, chlorite and hornblende.
443	Blackstock	Quartz, massive and crystalized.
587	Seneca	Feldspar. (orthoclase.)
588	London	Iron pyrites.
606	Antreville	Specimen composed of quartz, mica and iron pyrites; common garnet; massive quartz; hornblende.

628 Seneca.....Hornblendic rock.
Rock specimens composed of the following minerals : Feldspar and quartz ; quartz hornblende and marcasite ; quartz, hornblende and feldspar ; hornblende and a little magnetite ; epidote and hornblende; epidote, hornblende and feldspar ; hornblende and feldspar ; quartz, feldspar and mica ; pyroxene ; actinolite ; black mica, (biotite and lepidomelane.)

632 Liberty.....Rock specimens composed of the following minerals : Quartz, feldspar and epidote ; quartz, hornblende and mica ; decomposed feldspathic rock ; quartz with magnetite ; smoky quartz.

634 Majors.....Rock specimens composed of quartz, hornblende and mica.

688 Pendleton....Iron pyrites altered partly to limonite.

653 Westminster..Quartz, alone and associated with the following minerals : Mica ; mica and pyrites; hornblende ; tourmaline ; limonite ; common garnet with partially decomposed pyrites.

(5.)—CLAYS.

Analysis of Material dried at 110°–115°c.

Analysis No.	Sent on from	Silica	Alumina	Sesquioxide of Iron	Manganese Oxide	Lime	Magnesia	Alkalies	Combined Water	Total
344	Camden	47.46	36.83	2 60	Trace	0.22	0.13	Undet'd	12.97	100.21
*345	"	52.34	34.02	2.05	"	0.31	Trace	"	11.54	100.26
346	"	55.94	30.82	2.29	"	0.23	0.13	"	10.31	99 72
347	"	59.74	28.46	2.01	"	0.26	0.20	"	9.59	100.26
354	Fort Motte	79.47	9.92	2.88	.....	0.71	0.78	"	5.24	99.00

*Nos. 345, 346, 347 said to be from same bed ; 345 " from top," 346 " from middle," 347 " from bottom." A partial examination was made of two other clays, Nos. 341 and 355, the first a yellow clay mistaken for yellow ochre ; the other, a kaolin.

(6.)—MARLS.

Analysis No.	Sent on from	Carbonate of Lime	Carbonate of Magnesia	Phosphate of Lime	Sulphate of Lime	Oxides of Iron and Alumina	Sand and Clay	Combined Water and Organic Matter	Moisture at 100° c.	Total
337	Edgefield	Undet'd	Undet'd	4.87	Undet'd	Undet'd	37.83	Undet'd	Undet'd	.....
593	Columbia	31.14	0 21	0.20	.....	3.55	55.72	2.65	6.53	100.00
605	Bucksport	39.92	0.19	0.09	0.47	1.83	55.36	1.32	0.75	99.93

(7.)—MISCELLANEOUS ARTICLES.

Station Number	Sent on from	
342	Greers.....	Subsoil, "from a boggy place" Decomposing mica-schist impregnated with sulphate of iron (ferrous and ferric,) sulphates of alumina, lime, magnesia, soda, potash and lithia.
351	Rock Hill..	"Cotton seed fibre" as a fertilizer. Total phosphoric acid.....0.168 p. c. Nitrogen .....0.610 " Equivalent to ammonia.....0.740 " Potash soluble in water.....0.580 " Sample was pale brown from adhering particles of hulls and meal.
610	Camden....	Samples of sugar beets :—For analysis, see Section IV.

The remaining miscellaneous specimens are not of sufficient interest to be referred to in detail in this report.

It is respectfully requested that all persons sending on specimens for analysis shall be required to give the exact localities of the waters, ores, minerals, etc., from which the samples are taken.

Very respectfully,

M. B. HARDIN.

PENDLETON, S. C., June 30th, 1892.

P. H. E. Sloan, Treasurer, in account with South Carolina Experiment Station.

1891			
July 10.	To U. S Treasury Warrant	$3,750 00	
Oct. 8.	" " " "	3,750 00	
1892.			
Jan. 7.	" " " "	3,750 00	
April 6.	" " " "	3,292 15	
			$14,542 15

CREDITS.

By Salaries	$4,812 47	
" Labor	3,087 80	
" Supplies	2,646 69	
" Freight and Express	166 98	
" Postage and Stationery	105 86	
" Printing	591 46	
" Library	130 27	
" Tools and Implements	403 69	
" Scientific Instruments	91 50	
" Chemical Apparatus, etc	705 02	
" General Fittings	50 64	
" Buildings	750 00	
" Fences and Drainage	9 60	
" Live Stock	234 10	
" Traveling	57 87	
" Incidental Expenses	29 78	
" Seeds and Plants	553 06	
" Repairs	115 36	
		$14,542 15

P. H. E. SLOAN,
Treasurer South Carolina Experiment Station.

The undersigned Auditing Committee of the Board of Trustees of Clemson Agricultural College for the Experiment Station having duly examined the Vouchers of the Treasurer for the year ending 30th June, 1892, Nos. 1 to 223,

inclusive, and compared the same with the original bills, do hereby certify that all of the said expenditures have been duly authorized and approved by the proper authorities and are sustained by the Vouchers.

JAS. L. ORR.
J. E. BRADLY.
M. L. DONALDSON.